

What is claimed is:

1. An air induction control apparatus for an internal combustion engine comprising:
 - 5 a throttle valve supported by a throttle shaft rotatably within an intake air passage to control the quantity of intake air flowing through the intake air passage;
 - an actuator working to produce an output which rotates the throttle shaft for opening and closing said throttle valve selectively
 - 10 between a fully closed portion and a fully opened position;
 - a first stopper defining a middle position at which said throttle valve is held between the fully opened and closed positions when said actuator outputs no torque;
 - an opener member connected to the throttle shaft to be rotatable together with the throttle shaft;
 - 15 a first spring winding disposed so as to exert a first spring pressure on said opener member in a first rotational direction in which said throttle valve is rotated from the fully opened position to the middle position, when said actuator produces no output, said
 - 20 first spring winding being urged at an end thereof into constant engagement with said first stopper to hold said opener member from rotating in a second rotational direction in which said throttle valve is rotated from the fully closed position to the middle position; and
 - 25 a second spring winding having a first and a second end between which said opener member extends, when said actuator produces no output, the first end abutting against a second stopper,

the second end abutting against said opener member so as to exert a second spring pressure on said opener member in the second rotational direction to nip said opener member between the second end of said second spring winding and the end of said first spring winding elastically through the first and second spring pressures, thereby holding said throttle valve at the middle position.

2. An air induction control apparatus as set forth in claim 1, wherein said first and second stoppers are formed by a one-piece member having a plane against which the end of said first spring winding and the first end of said second spring winding abut.

10

3. An air induction control apparatus as set forth in claim 1, wherein the first and second stoppers have surfaces rounded so as to establish a point contact with the end of said first spring winding and the first end of said second spring winding, respectively.

15

4. An air induction control apparatus as set forth in claim 1, further comprising a middle position adjusting mechanism designed to shift a contact of the end of the first spring winding with said first stopper in one of the first and second rotational directions to adjust the middle position to a desired one.

20

5. An air induction control apparatus as set forth in claim 1, further comprising a spring holder working to hold the end of said first spring winding and the first end of said second spring winding

25

from shifting out of engagement with the first and second stoppers.

6. An air induction control apparatus as set forth in claim 5,
wherein said spring holder is implemented by pins installed on said
5 opener lever.

7. An air induction control apparatus as set forth in claim 1,
wherein said second winding provides an elastic nip to said opener
member through the first and second ends of said second winding
10 within a range in which said throttle valve is rotated from the fully
opened position to the middle position.

8. An air induction control apparatus as set forth in claim 1,
wherein each of said first and second spring windings is made of a
15 coil spring having a given length extending parallel to the throttle
shaft.

9. An air induction control apparatus as set forth in claim 8,
wherein said first and second spring windings are wound in
20 alignment with each other around a shaft extending parallel to the
throttle shaft.

10. An air induction control apparatus as set forth in claim 8,
wherein said first and second spring windings are wound in
25 alignment with each other around a shaft extending in alignment
with the throttle shaft.

11. An air induction control apparatus as set forth in claim 1, wherein the first and second stoppers are implemented by a one-piece member formed on a throttle body, and wherein the end of 5 said first spring winding and the first end of said second spring winding are joined to each other to form a connection, the connection being urged into constant engagement with the one-piece member when said actuator outputs no torque.
- 10 12. An air induction control apparatus for an internal combustion engine comprising:
 - a throttle valve supported by a throttle shaft rotatably within an intake air passage to control the quantity of intake air flowing through the intake air passage;
 - 15 an actuator working to produce an output which rotates the throttle shaft for opening and closing said throttle valve selectively between a fully closed portion and a fully opened position;
 - a middle position hold stopper defining a middle position at which said throttle valve is held between the fully opened and closed 20 positions when said actuator outputs no torque;
 - an opener member connected to the throttle shaft to be rotatable together with the throttle shaft; and
 - 25 a spring made up of a first and a second winding and a third spring portion formed by a connection of the first and second windings, an end of the first winding opposite the third spring portion engaging a stopper formed on a throttle body so as to

produce a first spring pressure which urges the third spring portion in a first rotational direction in which said throttle valve is rotated from the fully opened position to the middle position, an end of the second winding opposite the third spring portion engaging said

5. opener member so as to produce a second spring pressure which urges said opener member in a second rotational direction in which said throttle valve is rotated from the fully closed position to the middle position, when said actuator produces no output, said third spring portion being held in engagement with said middle position

10. hold stopper to nip said opener member between the third spring portion and the end of the second winding elastically through the first and second spring pressures, thereby holding said throttle valve at the middle position.

15. 13. An air induction control apparatus as set forth in claim 12, wherein said middle position hold stopper has a surface rounded to establish a point contact with the third spring portion of said spring.

14. An air induction control apparatus as set forth in claim 12,

20. further comprising a middle position adjusting mechanism designed to shift a contact of the third spring portion of said spring with said middle position hold stopper in one of the first and second rotational directions to adjust the middle position to a desired one.

25. 15. An air induction control apparatus as set forth in claim 12, further comprising a spring holder working to hold the third spring

portion of said spring from moving out of engagement with said middle position hold stopper.

16. An air induction control apparatus as set forth in claim 15,
5 wherein said spring holder is implemented by pins installed on said
opener lever.

17. An air induction control apparatus as set forth in claim 12,
wherein said second winding provides an elastic nip to said opener
10 member through the third spring portion and the end of the second
winding within a range in which said throttle valve is rotated from
the fully opened position to the middle position.

18. An air induction control apparatus as set forth in claim 12,
15 wherein said spring is made of a coil spring having a given length
extending parallel to the throttle shaft.

19. An air induction control apparatus as set forth in claim 18,
wherein said coil spring is wound around a shaft extending parallel
20 to the throttle shaft.

20. An air induction control apparatus as set forth in claim 18,
wherein said coil spring is wound around a shaft extending in
alignment with the throttle shaft.